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Agricultural Machinery – Multicrop Juice Extractor – Methods of Test

BUREAU OF PRODUCT STANDARDS

DEPARTMENT OF TRADE & INDUSTRY PHILIPPINES

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National Foreword

This Philippine Agricultural Engineering Standards PAES 234:2008, Agricultural Machinery – Multicrop Juice Extractor – Methods of Test was approved for adoption as Philippine National Standard by the Bureau of Product Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center.

Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) through the project "Multicrop Processing Machines for Commercialization" funded by the Department of Science and Technology (DOST) through its Technology Innovation for Commercialization (TECHNICOM) Program and monitored by the Philippine Council for Agriculture, Forestry and Natural Resources Research Development (PCARRD).

For this standard, parameters for the purity of extracted juice is not included since further studies and testing are still needed to be established.

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate mandatory requirements to conform to the standard.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

In the preparation of this standard, the following documents/publications were considered:

AMTEC Test and Evaluation Report KOLBI Juice Extractor (for Arrowroot)

AMTEC Test and Evaluation Report Simplextractor-Coco Oil Expeller

Bates, R.P., J. R. Morris and P. G. Gandall. Principles and practices of small-and medium scale fruit juice processing. www.fao.org/docrep/005/Y2515E/y2515e00.htm.

Bautista, O.K. and H.B. Aycardo. Ginger: Its Production, Handling, Processing and Marketing with Emphasis on Export. Deratment of Horticulture, College of Agriculture, University of the Philippines Los Baños. 1979.

CIGR Handbook of Agricultural Engineering- Volume IV- Agro-Processing Engineering. Published by American Society of Agricultural Engineers.

Ginger Crop Guides: Postharvest Handling of Ginger. http://www.agribusinessonline.com/crops/gingerph.asp

Malinis, Arnulfo P. Development of the Integrated Multicrop Processing System (Zero Waste Ginger Procesing Technology). 2004.

PAES 231:2005 Agricultural Machinery – Coconut Expeller – Methods of Test

Recommended Code of Practice for Handling and Processing Muscovado Products

CONTENTS

ANNEXES

1 Scope

This standard specifies the methods of test and inspection for multicrop juice extractor used for mechanical extraction of juice from ginger, coconut, carrots, onion, lemon grass, pandan leaves, arrow root, cassava, sweet potato, garlic, herbal plants and vegetables leaves. Specifically, it shall be used to:

1.1 verify the mechanism, dimensions, materials, accessories of the multicrop juice extractor and the list of specifications submitted by the manufacturer;

1.2 determine the performance of the machine;

1.3 evaluate the ease of handling and safety features;

1.4 analyze the products of extraction through laboratory analysis; and

1.5 report the results of the tests.

2 References

The following normative documents contain provisions, which through reference in this text constitute provisions of these standards:

PAES 103:2000 Agricultural Machinery – Method of Sampling

PAES 234:2008 Agricultural Machinery – Multicrop Juice Extractor - Specifications

3 Definitions

For the purpose of this standard, the definitions given in PAES 234 and the following shall apply:

3.1
extraction efficiency
ratio between the total moisture extracted by the machine to the total initial moisture content of the crop

3.2
extraction loss
difference between the total amount of potential juice content and total amount of juice recovered

3.3
extraction rate
quantity of juice that the extractor can obtain per unit of time, expressed in kilogram per hour

3.4
juice quality
refers to the physical and chemical properties of juice extracted

3.5
juice recovery
ratio of the extracted juice and the total weight of the input crop, expressed in percent

3.6
meal
residues of the test materials after juice extraction

3.7
potential juice content
initial moisture content of the crop

3.8
morphological properties
properties of the test material which deal with its anatomical characteristics such as length, width and thickness.

3.9
running-in period
preliminary operation of the machine to make final adjustments prior to the conduct of test

4 General Conditions for Test and Inspection

4.1 Selection of multicrop juice extractor to be tested
Machine submitted for test shall be sampled in accordance with PAES 103.

4.2 Role of manufacturer/dealer
The manufacturer shall submit specifications and other relevant information about the multicrop juice extractor and shall abide with the terms and conditions set forth by an official testing agency.

4.3 Role of the operator
An officially designated operator shall be skilled and shall demonstrate, operate, adjust, repair as the case maybe, related to the operation of the machine.

4.4 Test site conditions
The site should have ample provisions for material handling, temporary storage, work space and normal working conditions.

4.5 Termination of Test

If during testing, the machine stops due to major component breakdown or malfunctions, the test engineer from the official testing agency shall terminate the test.

5 Test Preparation

5.1 Test instruments

The instruments to be used shall have been calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum field and laboratory test equipment and materials needed to carry out the multicrop juice extractor test is shown in Annex A.

5.2 Test material

Test materials to be used shall be any of the following crops; ginger, coconut, carrots, onion, lemon grass, pandan leaves, arrow root, cassava, sweet potato, garlic, herbal plants and vegetables leaves with the following characteristics:

5.2.1 Test material characteristics

5.2.1.1 Variety : locally grown (as much as possible single variety)

5.2.1.2 Condition : shredded (if necessary)

5.2.1.3 Quantity to be supplied

The amount of test material that will be used in performing the test shall be at least 75 % of input capacity.

5.3 Sample Preparation

Prepare the test material in such a way that the test sample for each trial shall have identical characteristics in terms of variety and condition and date of harvest. Care should be taken so as to prevent alterations of the conditions of the test materials.

5.4 Running-in and preliminary adjustment

Before the start of the test, the multicrop juice extractor should have undergone running-in period wherein various adjustments of the multicrop juice extractor shall be made according to the recommendation of the manufacturer. No other adjustments shall be permitted while the test is on-going.

6 Pre-test Observation

6.1 Verification of the manufacturer's technical data and information

This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the multicrop juice extractor in comparison with the list of manufacturer's technical data and information.

6.2 A plain and level surface shall be used as reference plane for verification of multicrop juice extractor dimensional specifications.

6.3 The items to be inspected and verified shall be recorded in Annex B.

7 Performance test

This is carried out to determine overall machine performance.

7.1 Operation of the multicrop juice extractor

The multicrop juice extractor shall be operated at the recommended settings of the manufacturer. After each test trial, the extracting mechanism and chamber shall be cleaned and then prepared for the next test trial.

7.2 Test Trial

A minimum of three (3) test trials, with duration of at least 15 minutes per trial, shall be adopted.

7.3 Duration of Test

The duration of each test trial shall start with the loading of test materials into the hopper and ends after the last meal is discharge through the meal outlet.

7.4 Sampling

7.4.1 Sampling procedure for test materials

Before the start of the test trials, randomly take approximately three (3) kilograms sample for determination of input material condition

7.4.2 Sampling from meal outlet

During each test trial, three (3) sets of 100 g samples shall be randomly collected from the meal outlet of the multicrop juice extractor to be analyzed in the laboratory.

7.4.3 Handling of Samples

All samples shall be placed in appropriate containers, properly labeled and sealed.

7.5 Data Collection

7.5.1 Noise level

The noise emitted by the machine shall be measured using a noise level meter at the location of the operator and collector. The noise level shall be measured approximately 50 mm away from the ear level of the operator and collector.

7.5.2 Speed of Components

The speed of the rotating shafts of the major components of the multicrop juice extractor shall be taken using tachometer.

NOTE Measurements shall be taken with and without load for sub-clauses 7.5.1 and 7.5.2 as specified in Annex C. Measurements with load shall be randomly taken during the duration of each test trial.

7.5.3 Fuel/Power Consumption

Before the start of each trial, the fuel tank shall be filled to its capacity for internal combustion engines used as power source. After each test trial the tank shall be refilled using graduated cylinder. The amount of refueling is the fuel consumption for the test. When filling up the tank, keep the tank horizontal so as not to leave empty space in the tank.

In case an electric motor is used as the prime mover, a power meter shall be used to measure electric energy consumption. Measurement shall be randomly taken during the duration of each test trial.

7.6 Data recording and observations

Record sheet for all data and information during the test is given in Annex C.

8 Laboratory Analysis

Laboratory analysis shall be used to determine morphological properties and moisture content of the test materials. The laboratory test data sheet to be used is given in Annex D.

8.1 Morphological Properties

Measure and record the dimension, i.e. length, diameter, width and thickness of the leaves and stalks of the crop used in the test.

8.2 Moisture Content

This shall be taken following the standard procedures for oven-dry method (wet basis).

8.2.1 For each test trial, select three (3) representative samples weighing at least 25 g of test materials and place them in the moisture can. The moisture cans shall be sealed to ensure that no moisture is lost or gained by the samples between the times they were weighed. Record the initial weight.

8.2.2 Dry the samples in the oven with temperature of 103 °C – 105 °C for at least 24 hours.

8.2.3 After removing the samples from the oven, it should be placed in desiccators and allowed to cool to ambient temperature.

8.2.4 Weigh each moisture cans including the dried sample. Record the final weight. Calculate the moisture content using the equation in Annex E.

9 Formula

The formulas to be used during calculations and testing are given in Annex E.

10 Test Report

The test report shall include the following information in the order given:

10.1 Title

10.2 Summary

10.3 Purpose and Scope of Test

10.4 Methods of Test

10.5 Description of the Machine

Table 1 – Machine Specifications

10.6 Results and Discussions

10.7 Observations (include pictures)

Table 2 –Performance test data

10.8 Name/s, signature/s and designation of test engineers

Annex A
(informative)

Minimum List of Field and Laboratory Test Equipment and Materials

A.1	**Equipment**	**Quantity**
A.1.1	**Field**	
A.1.1.1	Tachometer (contact type or photo electric type) Range: 0 rpm to 5,000 rpm	1
A.1.1.2	Digital timers (range: 60 minutes) Accuracy: 0.1 sec	2
A.1.1.3	Tape measure (with maximum length of 5m)	1
A.1.1.4	Noise level meter Range: 30 dB (A) to 130 dB (A)	1
A.1.1.5	Portable Digital Scale (capacity: 100 kg) Scale divisions: 500 g or Weighing scale (capacity: 100 kg) Scale divisions: 500 g	1
A.1.1.6	Graduated cylinder (for engines) (500 mL capacity) or power meter (for electric motors) 60 Hz, 220 V	1
A.1.1.7	Vernier Caliper Accuracy: 0.1 mm	1
A.1.1.8	Camera	1
A.2	**Laboratory**	
A.2.1	Air Oven	1
A.2.2	Desiccator	1
A.2.3	Electronic balance Sensitivity: 0.1 g	1
A.3	**Materials**	
A.3.1	Pail for extracted juice and test material meal	2
A.3.2	Moisture Cans	
A.3.3	Sample bags	
A.3.4	Labeling tags which include	
A.3.4.1	Date of test	
A.3.4.2	Multicrop juice extractor on test	
A.3.4.3	Sample source	
A.3.4.4	Variety	
A.3.4.5	Trial number	

Annex B
(informative)

Specifications of Multicrop Juice Extractor

Name of Applicant/ Distributor: _____
Address: _____
Tel No: _____
Name of Manufacturer: _____
Address: _____
Tel No: _____

GENERAL INFORMATION

Make: _____ Type: _____
Serial No: _____ Brand/Model: _____
Production date of Multicrop Juice Extractor to be tested: _____
Testing Agency: _____ Test Engineer: _____
Date of Test: _____ Location of Test: _____

Items to be inspected

ITEMS	Manufacturer's Specification	Verification by the Testing agency
B.1 Main structure		
B.1.1 Overall dimensions, mm		
B.1.1.1 length		
B.1.1.2 width		
B.1.1.3 height		
B.1.2 Weight, without prime mover (kg), if applicable		
B.2 Hopper		
B.2.1 Material		
B.2.2 Thickness, mm		
B.2.3 Height from the ground, mm		
B.2.4 Location		
B.3 Power Transmission		
B.3.1 Pulley		
B.3.1.1 Type		
B.3.1.1 Dimension, mm		
B.3.1.2 Speed Reducer Input Shaft		
B.3.1.2.1 Type		
B.3.1.2.2 Dimension, mm		
B.4 Extraction Chamber		
B.4.1 Extractor Shaft		
B.4.1.1 Type		
B.4.1.2 Length, mm		
B.4.1.3 Outer diameter, mm		
B.4.1.4 Pitch, mm		
B.4.1.5 Material		
B.5 Main Frame		

ITEMS		Manufacturer's Specification	Verification by the Testing agency
B.5.1	Material		
B.5.2	Thickness, mm		
B.6	Prime mover		
B.6.1	Electric motor		
B.6.1.1	Brand		
B.6.1.2	Make or manufacturer		
B.6.1.3	Serial No.		
B.6.1.4	Type		
B.6.1.5	Rated Power, kW		
B.6.1.6	Rated Speed, rpm		
B.6.1.7	Frequency, Hz		
B.6.1.8	Voltage		
B.6.1.9	Weight, kg		
B.6.2	Engine		
B.6.2.1	Brand		
B.6.2.2	Model		
B.6.2.3	Make or manufacturer		
B.6.2.4	Serial No.		
B.6.2.5	Type		
B.6.2.6	Rated Power, kW		
B.6.2.7	Rated Speed, rpm		
B.6.2.8	Displacement (cm^3)		
B.6.2.9	Cooling system		
B.6.2.10	Starting system		
B.6.2.11	Weight, kg		

Annex C
(informative)

Performance Test Data Sheet

Test Trial No. _____ Date: _____
Test Engineer: _____ Location: _____
Assistants: _____ Test Specimen: _____
Test Requested by: _____ Manufacturer: _____

ITEMS	Trial 1	Trial 2	Trial 3	Ave.
C.1 Crop condition				
C.1.1 Crop used				
C.1.2 Variety				
C.1.3 Crop source				
C.1.4 Date harvested				
C.1.5 Length				
C.1.6 Thickness				
C.1.7 Width of leaf/stalk				
C.1.7.1 Base				
C.1.7.2 Middle				
C.1.7.3 Tip				
C.1.8 Thickness of leaf/stalk				
C.1.8.1 Base				
C.1.8.2 Middle				
C.1.8.2 Tip				
C.1.9 Age of the crop				
C.2 Weight of Input, kg				
C.3 Input capacity, kg/h				
C.4 Operating time, h				
C.5 Juice recovered, kg				
C.6 Juice recovery, %				
C.7 Test Material meal recovered, kg				
C.8 Test material meal recovery, %				
C.9 Extraction loss, %				
C.10 Extraction Recovery, %				
C.11 Juice extraction rate, kg/h				
C.12 Extraction efficiency, %				
C.13 Speed of Components, rpm				
C.13.1 Electric Motor				
C.13.1.1 Without load				
C.13.1.2 With load				
C.13.2 Reducer Shaft				
C.13.2.1 Without load				
C.13.2.2 With load				
C.13.3 Extractor Shaft				
C.13.3.1 Without load				

C.13.3.2 With load				
C.14 Noise Level, dB(A)				
C.14.1 Without load				
C.14.2 With load				
C.15 Power Consumption				
C.15.1 Power, kW				
C.15.1.1 Without load				
C.15.1.2 With load				
C.15.2 Voltage, V				
C.15.2.1 Without load				
C.15.2.2 With load				
C.15.3 Current, A				
C.15.3.1 Without load				
C.15.3.2 With load				
C.16 Fuel consumption				
C.16.1 Fuel time, h				
C.16.2 Fuel consumed, L				

C.17 Rate the following observations:

Items	**Rating***				
	1	**2**	**3**	**4**	**5**
C.17.1 Ease of loading					
C.17.2 Ease of cleaning parts					
C.17.3 Ease of adjusting and repair of parts					
C.17.4 Ease of collecting output					
C.17.5 Ease of transporting the machine					
C.17.6 Safety					
C.17.7 Vibration					

*1 – Very good
2 - Good
3 - Satisfactory
4 - Poor
5 – Very poor

C.18 Other Observations:

_____

_____

_____

Annex D
(informative)

Laboratory Test Data Sheet

Machine Tested: _____

Analyzed by: _____

D.1 Moisture Content Determination

Sample Material	Initial Weight, W_i				Final Weight, W_f				% MC			
	Trial 1	Trial 2	Trial 3	Ave	Trial 1	Trial 2	Trial 3	Ave	Trial 1	Trial 2	Trial 3	Ave
Crop used												
Input test material												
Test material meal												

Annex E
(informative)

Formula Used During Calculations and Testing

E.1 Input Capacity, kg/h

$$C_i = \frac{Wi}{Ti}$$

where:

Ci = Input Capacity, kg/h
W_i = Weight of input material, kg
T_i = Time required to empty the hopper of the input material, h

E.2 Juice recovery, R_o (%)

$$Ro = \frac{Wf}{Wi} x100$$

where:

R_o = Juice Recovery, %
W_f = Weight of extracted juice collected from juice outlet, kg
W_i = Weight of input material, kg

E.3 Test material meal recovery, M_r (%)

$$Mr = \frac{Wm}{Wi} x100$$

where:

M_r = Test material meal recovery, %
W_m = Weight of meal collected, kg
W_i = Weight of input material, kg

E.4 Extraction rate, E_r (kg/h)

$$Er = \frac{Wf}{Tt}$$

where:

E_r = Extraction rate, kg/h
W_f = Weight of juice collected, kg
T_t = Total operating time, h

E.5 Extraction recovery, R_e(%)

R_e = $100 - E_L$, %

where:

R_e = Extraction recovery, %
E_L = Extraction losses, %

E.6 Extraction Losses, E_L (%)

$$E_L = \frac{W_L}{W_{TJ}} x\, 100$$

Where:

E_L = Extraction losses, %
W_L = Weight of juice collected other than from juice outlet, kg
W_{TJ} = Total weight of extracted juice, kg
= $W_f + W_L$

E.7 Potential Juice Content, P_{JC} (kg)

$$P_{JC} = \frac{MC_i}{100} x\, W_i$$

where:

P_{JC} = Potential juice content, kg
MC_i = Initial moisture content of crop, %
W_i = Weight of input material, kg

E.8 Extraction efficiency, Eff (%)

$$Eff = \frac{W_{TJ}}{P_{JC}} x100$$

where:

Eff = Extraction efficiency, %
W_{TJ} = Total weight of extracted juice, kg
= $W_f + W_L$
P_{JC} = Potential juice content, %

E.9 Moisture Content, MC (%)

$$MC = \frac{W_{is} - W_{fs}}{W_{is}} x100$$

where:

MC = moisture content, %
W_{is} = initial weight of samples, g
W_{fs} = final weight of samples, g

E.10 Fuel/Electrical energy consumption

E.10.1 Electrical energy consumption

$$E_c = \frac{PcTo}{Wi}$$

where:

E_c	=	Electrical energy consumption, kW-h/kg
P_c	=	Power consumed, kW
T_o	=	Time of operation, h
W_i	=	Weight of input material, kg

E.10.2 Fuel consumption

$$F_c = \frac{F_l}{T_o}$$

where:

F_c	=	Fuel consumption, L/h
F_l	=	Amount of fuel consumed, L
T_o	=	Time of operation, h